The role of transport processes on dielectric elastomer performance

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A dielectric elastomer (DE) is a thin elastomer film sandwiched between two compliant electrodes, and upon application of an electrical field the DE increases in area and decreases in width. DEs are soft transducers that can be used as actuators, generators and sensors. They are sought optimized by various means, but most of them include introducing high-permittivity particles into the elastomer film. These particles should theoretically increase the actuation performance, but unfortunately they also causes premature electrical breakdown to occur.

The scope of this project is to understand the parameters that lead to breakdown by modelling the performance of DEs during operation. A breakdown may arise from the effect of several different electrical aging mechanisms, which can be categorized as either degradation or intrinsic breakdown mechanisms based on the required time to cause a breakdown of the materials, illustrated in Figure 1. The mechanisms of most importance are electrical and thermal breakdown, which are also the ones of most interest in this project. A preliminary model of thermal breakdown will be used as one of the starting points for further modelling of breakdown of DEs during operation.

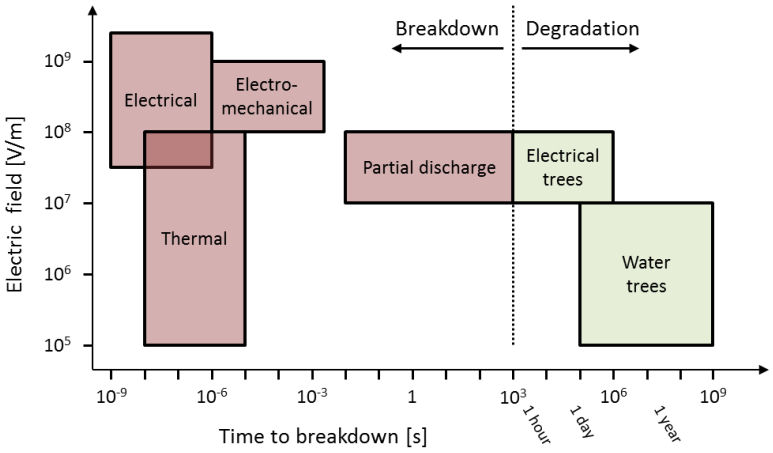

Figure 1: Schematic overview of different types of electrical aging mechanisms that a dielectric elastomer can be subjected to.